

BLOOD RELATIONSHIPS.

Blood Immunity and Blood Relationship; a Demonstration of Certain Blood-relationships amongst Animals by Means of the Precipitin Test for Blood.

By George H. F. Nuttall, M.A., M.D., Ph.D. Pp. 444. (Cambridge: University Press, 1904.)

TSCHISTOWITSCH was the first to observe that if a rabbit were subjected to repeated injections of serum from an animal of a different species, it reacted to the introduction of the foreign proteid by forming and accumulating in its blood a substance which, when added to a solution of the particular serum injected, gave rise to a precipitate. These experiments at once aroused considerable interest, and were confirmed and extended by a number of observers on account of their importance in relation to the processes whereby the organism protects itself against the introduction of proteid poisons and micro-organisms by the formation of so-called anti-bodies.

The interest of the observations is not, however, confined to the doctrine of immunity, for fuller knowledge of the phenomena has shown them to have important applications to both forensic medicine and zoology. The value to the former was pointed out by Uhlenhuth and others, who directed attention to the fact that the serum of an animal previously subjected to repeated injections of human serum forms a very sensitive test for the same, and can therefore be used for the detection of human blood. The importance of precipitin phenomena to the zoologist has been particularly insisted upon by Dr. Nuttall, and the present volume is largely concerned with results of interest from this point of view.

When the precipitins were first discovered, it was concluded that the reaction was strictly specific, and that the serum of an animal injected with human serum only formed precipitates with the serum of man, and one injected with ox-serum only when added to the serum of the ox. Nuttall and Uhlenhuth showed, however, that no such hard and fast line could be drawn. Indeed, the development of our knowledge of the specificity of the precipitin reaction is in great measure due to the work of Dr. Nuttall and to that of his pupils, Drs. Graham Smith and Sangar. However, although not strictly specific, a precipitin precipitates the serum of the same species of animal as that used in its preparation more readily and in greater amount than that of animals of other species, and the difference is least marked when the animals are closely related, as in the case of the horse and the donkey. From these results, Dr. Nuttall conjectured that the varying degree to which a precipitin reaction occurred might afford a valuable indication as to blood relationship.

The present volume contains the results of experiments, undertaken by the author in conjunction with Drs. Graham Smith and Sangar, with a large number of anti-sera upon the blood of 586 different species of animals.

The book is divided into two parts. Part i. is devoted to a condensed summary of our knowledge on anti-bodies in general. It commences with a brief

but clear account of Ehrlich's theory regarding the formation of anti-toxins and anti-bodies generally. This is followed by a series of paragraphs on ferments and anti-ferments, cytotoxins, hæmolysins, bacteriolysins, agglutinins, &c., which in style suggests the pages of a technological dictionary. Short sentences, each pregnant with some fact, and with reference attached, follow one another in bewildering succession. Many of these are contradictory, and it is to be regretted that there is no summing up by the author at the end of each paragraph.

This portion of the book does great credit to the author's industry and scholarship, but it makes impossible reading, and is only serviceable to one knowing the subject and wanting the references. After fifty pages one is glad to reach the end of part i., and to come to the subject-matter proper of the book, viz. the precipitins.

Part ii. commences with the methods for obtaining precipitating anti-sera. The style now leaves little to be desired, and this account is delightfully clear and complete, so that anyone wishing to repeat the experiments could hardly fail for want of adequate instructions. Sections ii. and iii. contain nearly all that is known of the nature of precipitin reactions and the effects of heat, peptic and tryptic digestion, filtration and putrefaction, upon both precipitins and precipitable substances. On p. 126, however, the statement is made that "no measurements of the amount of precipitin during the growth of immunisation have as yet been made which would correspond to those made upon antitoxin." One can only presume that this paragraph was written prior to the publication of von Dungern's quantitative experiments with the precipitins obtained by the injection of crab-plasma.

Section iv. deals with the specificity of the precipitins. After historically reviewing the views of different experimenters on this subject, and showing that increased knowledge has fully confirmed his earlier contentions against the absolute specificity of precipitin reactions, the author expresses himself as in entire agreement with the remark of Linoisier and Lemoine: "Là où on a cru voir une action spécifique, un examen attentif ne permet de voir qu'une action particulièrement intense."

Section v. treats of precipitins obtained by the injection of other proteids from bacteria, milk, and higher plants. In section vi. are given in tabular form the results of 16,000 tests of 30 anti-sera with the bloods of a large number of animals. This particular series is not quantitative, and was presumably made before the author had devised his quantitative method, the reactions being entered as "full," "marked," "medium," "faint," and "nil." This is followed by a later series of 500 experiments made in conjunction with Strangeways with a quantitative method devised by the author, whereby the dilution of the serum and the time of reaction being constant, the actual volume of the conglomerated precipitate is measured in an ingenious way. The volume of the precipitate, with the homologous serum, is taken as the unit, and the volumes obtained with the sera of other animals are expressed in percentages of this unit.

The method and the interest of the facts brought to light by it will be clearer from two short examples.

Amount of precipitate obtained by adding anti-human serum to the serum of man and apes (expressed as percentages) :—

Man	100
Ourang	80
<i>Cynocephalus mormon</i>	50
<i>Cercopithecus petaurista</i>	50
<i>Ateles vellerosus</i>	25

Amount of precipitate obtained in a similar way by adding anti-horse serum to the serum of horse, donkey, zebra :—

<i>Equus caballus</i>	100
<i>Equus asinus</i>	84
<i>Equus grevyi</i>	58

Tested in this way the indications of blood relationship between man and the ourang are comparable to those between the horse and the donkey. The serum of other mammalia gave but traces of precipitate with the above anti-sera, and that of other vertebrates none at all.

In these precipitin-phenomena we have perhaps a really physiological test of blood relationship, and that, as the author suggests, "a common property has persisted throughout the ages which have elapsed during the evolution of animals from a common ancestor in spite of differences of food and habits of life." Anomalies do undoubtedly occur when working with any particular anti-serum, so that all conclusions must be controlled by experiments with anti-sera prepared from different individuals. Section viii. contains the results of 2500 similar tests, undertaken by Graham Smith, in the application of the method to the lower vertebrates and invertebrates. These will be of no less interest to zoologists, but space prevents our entering upon further particulars.

The ninth and last section deals with the practical application of precipitin reactions to legal medicine. As the precipitable substance in sera is a relatively stable body, is very resistant to the action of putrefactive organisms, and is not destroyed by drying, the detection of human blood by this means is not confined to stains of recent origin. Indeed, Graham Smith and Sangar have examined a large number of articles from the collection of the Criminal Investigation Department, Scotland Yard, and have succeeded in identifying human blood stains which were thirty years old.

The fact that anti-human serum forms precipitates to some extent when added to the serum of monkeys does not seriously diminish the forensic value of the precipitin test for human blood, for the plea that suspected bloodstains were of simian origin would seldom be raised and hardly ever substantiated.

The volume concludes with an excellent bibliography on precipitins and allied subjects which occupies sixteen pages!

In addition to containing the methods and experimental results whereby the author and his associates, Drs. Graham Smith and Sangar, have tested and developed the precipitin reaction as an indication of

blood relationship, the book contains practically all that is known on the subject of precipitins up to the present time, and will therefore be indispensable to anyone desiring to become acquainted with or to work upon this subject.

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THE MOON.

The Moon. A Summary of the Existing Knowledge of our Satellite, with a Complete Photographic Atlas. By Wm. H. Pickering. Pp. xii + 102; 100 illustrations. (New York: Doubleday, Page and Co., 1903.) Price 10 dollars net.

IT has so long been taught that the moon is a world on which nothing ever happens that it may come as a surprise to many to learn that the probability of frequent changes in the lunar surface is now seriously advocated. The author of this book, who is a well known American astronomer, is convinced that there are daily alterations over small areas which cannot be explained either by shifting shadows or varying librations, and therefore infers that there are real changes in the surface detail. The observations on which this conclusion is based are collected in the present volume, which also includes a more general account of our satellite, and contains the first complete photographic atlas which has yet been published.¹

To make a thorough study of the moon, Prof. Pickering some years ago suggested the use of a telescope of great focal length, and, as so frequently happens in America in such circumstances, the generosity of two anonymous donors enabled him to try the experiment. The instrument actually employed was a 12-inch objective of 135 feet focal length, giving a direct image of the moon nearly 16 inches in diameter, and to obtain the advantage of such "steady" atmospheres as can only be found in low latitudes it was taken out to Jamaica and set up at Mandeville, 2080 feet above sea-level. The long telescope tube was erected on the side of a convenient hill with its axis in the direction of the pole, and light was reflected into it at the lower end by a clock-driven mirror. The instrument was so far successful that all the negatives for the atlas were obtained within seven months.

The atlas shows the lunar surface in sixteen sections, each of which is exhibited under five different conditions of illumination, and there is in addition a good picture of the full moon, with the necessary key maps, besides other illustrations of interest. Although the photographs are not all of the finest definition, the completeness of the series gives them a special value, and the atlas will doubtless prove extremely useful to all who are engaged in lunar studies.

Apart from the photographs, the chief interest of the book lies in the observations and arguments which are put forward in favour of lunar activities. The moon is so near that no improbably great area need be affected to make a change visible to an observer on the earth, but any real variations are liable to be

¹ The atlas is also published in the *Annals* of the Harvard Observatory, vol. II., 1903.